RC25 Disk Subsystem

digital

The RC25 Fixed/Removable Disk Subsystem

The RC25 mass storage subsystem is a unique alternative to conventional low-end disk and tape technology.

The RC25 is a complete subsystem, with 52 Mbytes of formatted user data, in one of the industry's smallest packages. It contains many of the same features as larger, more expensive subsystems, like an intelligent controller and complete onboard microdiagnostics. That's impressive enough, but what truly distinguishes the RC25 is that it combines the high performance and reliability of fixed-media disks with the convenience of a removable disk cartridge.

Flexibility is the RC25's long suit. It's ideal for both single- and multiple-user environments. The removable catridges are perfect for personal data storage and data interchange. Because the cartridge drive uses the same spindle and offers the same capacity and high-performance capabilities of the Winchester disk, the RC25 gives you another attractive option: very fast backup.

Combine all of these advantages with exceptional reliability and ease of use, and RC25 stands out as a clear choice for many UNIBUS and Q-BUS systems' mass storage.

Highlights

- 52-Mbyte capacity in a small, inexpensive package makes the RC25 ideal for many low-end to midrange systems.
- A 26-Mbyte Winchester fixed disk and a 26-Mbyte sealed removable cartridge provide one-to-one backup ratio and an attractive alternative to disk/tape configurations.
- Impressive performance figures, including 20 to 35 millisecond average seek time and 1,250-Kbyte-per-second peak transfer rate, are typical of much larger, more expensive drives.
- Mass Storage Control Protocol (MSCP) support means that the RC25 is compatible with other Digital Storage Architecture disks.
- Exceptional reliability and data integrity features include a powerful 170-bit error detection and correction code, automatic retry and revectoring, embedded servos, and bad block replacement.
- The RC25 is easy to install, easy to use, easy to maintain for low cost of ownership.

RC25 – An Ingenious Alternative to the Limitations of Traditional Disks.

The RC25 is an attractively priced high-performance disk subsystem that provides 52 Mbytes of formatted storage capacity. Designed and manufactured by Digital, the RC25 effectively addresses many of the mass-storage problems faced by users of small to midsized computers.

For instance, the RC25 offers 26 Mbytes each of fixed and removable media storage in a single drive, on a single spindle. The fixed disk gives you the same performance, reliability, and economy you have come to expect of proven Winchester technology. The rugged, removable disk cartridge brings another dimension to mass-storage capability. Imagine the possibilities: very fast one-to-one backup; inexpensive, large-capacity personal data packs for multiple-user situations; convenient and dependable transportation of data among systems.

Another remarkable feature of the RC25 is that it packs all of this capacity, performance, and capability into an exceptionally compact form factor. The complete subsystem, including the fixed/removable drive, power supply, intelligent controller, and host interface, fits into a footprint of less than 1.5 square feet. Two drives – 104 Mbytes of formatted storage – fit easily into a standard 10.5-inch enclosure.

The unique fixed/removable disk design, small footprint, light weight (50 pounds), and low power requirements combine to make the RC25 an exciting mass storage alternative.

The Single-Spindle Drive is Compact and Reliable.

The RC25 drive consists of the drive electronics, power supply, cooling and cleaning air system, rotary positioner, four heads, and two platters. The single 26-Mbyte fixed platter and the 26-Mbyte removable media cartridge are run on the same spindle and are powered by the same motor. This single-spindle subsystem means data can be interchanged and media copied without the need for a second storage device like a floppy, tape, or another disk. Single-spindle construction also makes the RC25 more compact and more mechanically reliable than competing dual-spindle devices.

The drive uses eight-inch coated oxide media for both the fixed and removable elements. A unique Digital design, the removable RC25 media cartridge is a sealed, contaminant-resistant unit that is easily loaded from the front of the drive.

Comes Complete with an Intelligent Controller.

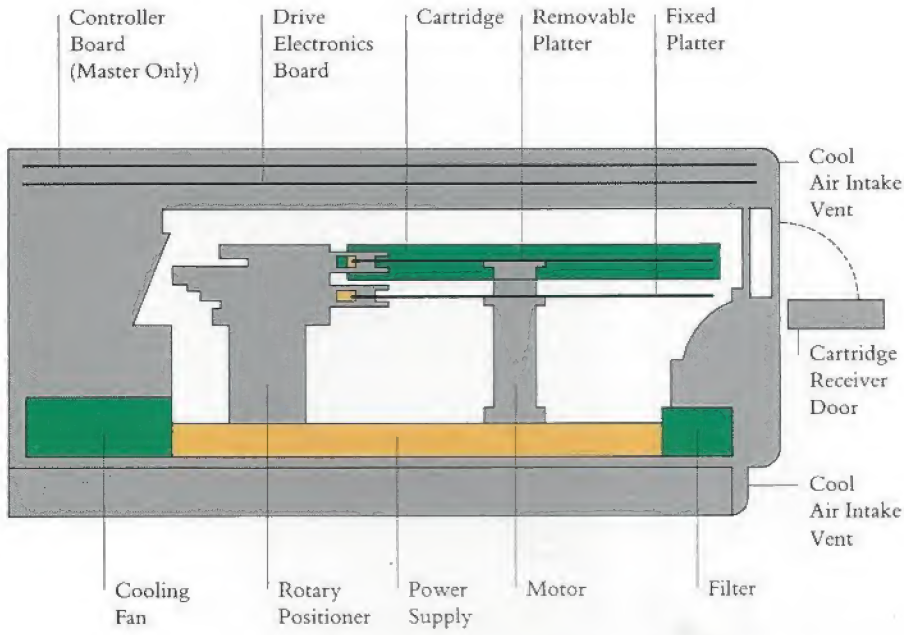
The RC25's single-card intelligent controller is part of the disk drive. This makes the RC25 unusual among comparable capacity disks. Traditionally, this class of storage subsystem was designed as drive-only: another manufacturer usually supplied the controller.

The controller is connected to the host via a lowend system interconnect (LESI) cable. Not only is the controller an integral part the RC25, but through advanced LSI circuitry and extensive microcoding it provides capabilities usually found only in more expensive, large-scale subsystems.

The controller manages disk accesses, data transfers, and performance optimizations. It also uses device-independent software through the Mass Storage Control Protocol (MSCP)—the same Digital Storage Architecture (DSA) protocol used by our UDA50 and HSC50 controllers for the RA-series of disks. Disk-dependent requirements like geometry and error recovery strategies are isolated from the host operating system by the MSCP device driver, which means an RC25 or any MSCP device can be connected to the host without the need to modify the existing operating system.

The RC25's unique internal intelligent controller makes the following key performance and reliability features of the RC25possible:

- Internal data buffering
- Seek ordering and overlapped seeks
- Spiral read/write
- Internal fault detection and isolation diagnostics
- Powerful error detection and correction codes
- Automatic retry and revectoring on errors
- Software compatibility with other MSCP devices
- Microprocessor-controlled servo-system



The RC25 single-spindle fixed/removable configuration

The RC25 disk cartridge is perfect for personal data storage.

High-Density Recording Provides Exceptional Capacity for the Cost and Size.

Over 12 million bits of user data space are stored on each square inch of recording surface of the RC25, for a formatted total of 52 million bytes. Two drives can be packaged in a 10.5-inch by 19-inch standard cabinet sharing or using the same controller. This high-density recording saves valuable space and yields an outstanding dollar-per-Mbyte and capacity-per-box ratio.

A Performer in a Class by Itself.

The RC25's 35-millisecond average seek time is at the high end of the performance spectrum, and when enhanced by the optimization features, reduces its seeks to as low as 20 milliseconds, the lowest of any fixed-and-removable subsystem available today.

The RC25's outstanding performance is due to its intelligent controller. This component is "smarter" than anything in its class; it contributes to the performance through several levels of optimization:

- Nine-sector data buffer – allows fine tuning of the drive speed to the needs of the host processor. This enhances the overall system operation speed.

- Seek ordering – sets up a command queue for the disk drive. The controller can rearrange and execute requests by closest cylinder address rather than in the order they were received. This elevator algorithm reduces seek distances for lower average access times with multiple requests.
- Overlapped seeks – can initiate simultaneous seeks for several I/O requests on a double-drive RC25 subsystem. This reduces seek time and allows one disk to transfer data at the same time seek operations occur on the other disk.
- Spiral data formatting – phases the data on successive tracks. This compensates for the single-track access time, and allows immediate reading of the requested data. It prevents lost time that results from a full rotation of the platter before a logically sequential but physically nonadjacent sector can be read.

Hardware Reliability: The Secret is Good, Solid Engineering.

The RC25's lower disk platter is permanently mounted. It resides within a virtually contaminant-free recording environment. Its rigidity permits precise head positioning, and the fixed media eliminates the need for routine head alignments.

The upper platter is enclosed in a removable, contaminant-resistant cartridge that is simply inserted onto the drive through an interlocked front door.

We've designed a unique hub/spindle interface to ensure a precise mating between the fixed and removable media platters. The single-spindle design promotes high reliability through mechanical simplicity. With the RC25's efficient layout, there are fewer parts that can break.

Thermal and air-speed sensors monitor air temperature and flow in the disks during spinup operations. The sensors protect both the drive and the media from degradation caused by extreme heat or line voltage fluctuation. They shut down the subsystem if a dangerous condition exists.

Data Integrity: No Stone Is Left Unturned.

The RC25 subsystem uses an improved method to handle media defects. These defects cause fragmented disk volumes that degrade performance and make data backup spotty and time-consuming. The host identifies a problem area as a bad block when it finds a defect that it can't correct. When the RC25 controller finds the bad block, it automatically refers to the nearest available replacement block. It doesn't need to seek out a lookup table. Because the file structure never has to be rearranged, revectoring promotes efficiency. Users can allocate large contiguous file areas without fear of possible bad sectors cropping up.

The RC25 subsystem features other outstanding data reliability characteristics.

- Enhanced error correction code (ECC) and error detection code (EDC). The drive can detect and correct any error up to eight eight-bit error bursts per sector. The controller appends an error detecting code to each data sector. The EDC logic checks for controller memory errors as well as verifies proper operation of the ECC hardware.
- Automatic sector reallocation. Even though the controller corrects data errors, it reports them to the host system, which automatically reallocates the sector if the error length exceeds a predefined threshold.
- Embedded servos. For the necessary track density, the RC25 uses an embedded servosystem where information is stored in the header record of each sector to align the head precisely over the correct track. This minimizes off-track errors.

Maintainability: It Almost Takes Care of Itself.

Besides hardware reliability, the RC25 subsystem has several important maintainability features that contribute to high system availability.

- Modular construction permits the entire RC25 package to be contained on only seven Field Replaceable Units (FRUs); internal microdiagnostics can isolate a problem, if one occurs, to one FRU with a high degree of accuracy. Repair is then a simple replacement procedure.
- The RC25 runs a series of selftests during spinup of the drive. If the selftests indicate a condition that may damage data or hardware, the drive will not load its heads, and notifies the operator of a problem via an LED display on the front panel.
- The RC25 subsystem contains unique fault-isolation diagnostics that indicate the failing component to the operator or field engineer.

The RC25 user-invokable and remote diagnostics include: a ROM-resident diagnostic that tests the controller and reports failure to the front panel; the error code invoked identifies the malfunctioning FRU; a host/front-end diagnostic that runs standalone to test the adapter, seeks, rotational times, basic read/write commands, and MSCP commands; a formatter that scans and replaces bad blocks; and various subsystem exercisers.

No Other Storage Subsystem Gives You All These Choices.

The RC25 gives you more choice in configuring the subsystem than tradition storage systems can possibly give. For instance, while the fixed and removable media construction is the most cost-effective functional design, the user may elect to ignore the fixed disk and operate the full subsystem as a 26-Mbyte removable drive. Conversely, the user can "lock" the removable cartridge in place to get a 52 Mbyte Winchester device.

The user can operate with any combination of fixed/removable RC25 storage, and use any other disk, tape, or floppy device in traditional modes.

Three configurations of the RC25 make it ideal for almost any computing environment:

- Tabletop package—a 10-inch by 10-inch by 20-inch self-contained subsystem, including controller and power supply.
- Rack-mount, single subsystem—resident in a CPU or expansion cabinet.
- Dual rack mount—two RC25 drives with one controller resident in a CPU or expander cabinet.

The RC25 can address most small to medium capacity needs for CPUs ranging from small PDP-11s through low-end 32-bit VAX systems.

A Faster, More Efficient Solution to the Backup Problem.

The RC25 is a complete mass storage subsystem requiring no additional storage support for data backup. The RC25 removable disk cartridge is the fastest, most efficient, and most economical medium for backing up the user data stored on the Winchester technology disk.

Because capacities of the two disks are identical, only one cartridge is required for data backup of the fixed platter. The RC25's cartridge matches the performance of the Winchester drive, so backup is accomplished in a very short time, freeing the RC25 to store and transfer new data. This method has a clear advantage over those storage systems that use tapes or floppy disks, where performance and capacities do not match.

One disk cartridge suffices for backup, so there's no need for space-consuming tape libraries or floppy disk storage facilities; and because the RC25 cartridge is sealed, there's little chance that the data will be damaged while stored.

The RC25 is a Member of a Family of Digital Disks.

The RC25 represents an important part of Digital's family of high-performance state-of-the-art disk subsystems. Because it implements most of the Digital Storage Architecture—the same architecture shared by our disks and controllers for large systems and even VAXclusters—the RC25 offers the opportunity for easy expansion as applications and databases grow.

The RC25 combines advanced technology and simplicity of operation.

digital

Specifications

Performance		
Peak transfer rate	1,250 KB/s	
Seek time	20-35 msec avg, 55 msec max	
Rotational latency	10.5 msec	
Average access time	30.5-45.5 msec (depending on queue length)	
Start time	60 sec (includes cartridge air purge)	
Stop time	30 sec	
Media Characteristics		
Formatted capacity	52 MB per drive, 26 MB per platter	
Tracks per inch	1,000	
Bits per inch	12,350	
Areal density	12.3 Mbits per square inch	
Rotational speed	2,850 r/min	
Number of data surfaces	4 (2 per platter)	
Number of heads per surface	1	
Servosystem	embedded	
Data Organization		
Sectors per track	31	
Bytes per track (host data)	15,872	
Tracks per surface (host data)	821	
Power Requirements	**120 V**	**240 V**
Phasing	single	single
Frequency	60 Hz	50 Hz
Starting current	10 A	6 A
Running current	2.55 A	1.28 A
Plug type	NEMA 5-15P	NEMA 6-15P
Receptacle type	NEMA 5-15R	NEMA 6-15R
Operational Environment		
Temperature range	10° to 40°C (50° to 104°F)	
Relative humidity	10 to 90%, noncondensing	
Max wet bulb	28°C (82°F)	
Heat dissipation	307 watts	
Altitude	2,450 m (8,000 ft)	
Physical Characteristics	**Tabletop**	**Rack Mount**
Height	25.6 cm (10.1 in)	26.4 cm (10.4 in)
Width	25.4 cm (10.0 in)	48.3 cm (19.9 in)
Depth	52 cm (20.5 in)	56.1 cm (22.1 in)
Weight	22.7 kg (50 lb)	single drive–29.5 kg (65 lb); dual drive–54.5 kg (120 lb)